

BIOMEDICAL APPLICATIONS

COURSE DESCRIPTION

This course is an overview of biomedical research applications. Topics covered will include understanding laboratory procedures fundamental to biomedical research in the areas of serology, microbiology, hematology, and DNA studies. Students will also understand the importance of the scientific method and documentation to all areas of research. Additional topics include communication skills, the history and development of the field of biomedical research and understanding the legal environment and technology transfer aspects of biomedical research.

It is strongly recommended that administration and guidance follow the scope and sequence and course recommendations as listed.

Recommended Credits: 1

Recommended Grade Level(s): 11-12th

Number of Competencies in Course: 46

Note: This course may be offered for one unit of science credit if the teacher is considered highly qualified in science or for one unit of career and technical education credit. This course may also be offered as a dual enrollment/dual credit course.

Teachers who teach this course must hold proper endorsement in Health Science Education and complete 16 hours of state approved training prior to teaching Biomedical Applications. If they continue after the first year they must attend 8 hours of state-approved training the following two years as approved by the state.

INTEGRATION/LINKAGES

Math, Chemistry, Biology, English, National Health Occupations Students of America Guidelines, National Science Standards, Industry Standards

BIOMEDICAL APPLICATIONS

STANDARDS

- 1.0** The student will know and apply the academic subject matter required to understand the history and development of the field of biomedical research.
- 2.0** The student will demonstrate proficiency in understanding basic skills and safety in the laboratory.
- 3.0** The student will apply social and ethical issues related to medical biotechnology.
- 4.0** The student will demonstrate an understanding of the relationship between protein and DNA.
- 5.0** The student will understand basic hematology.
- 6.0** The student will have an understanding of serology and immunology related to biotechnology.
- 7.0** The student will understand scientific concepts of microbiology.
- 8.0** The student will demonstrate knowledge of the scientific method in research and design.

BIOMEDICAL APPLICATIONS

STANDARD 1.0

The student will know and apply the academic subject matter required to understand the history and development of the field of biomedical research.

LEARNING EXPECTATIONS

The student will

- 1.1 Analyze the history of biomedical research in respect to time, culture, religion, and regions.
- 1.2 Connect biomedical terminology, including root words, prefixes, suffixes, and abbreviations with industry concepts and disciplines.
- 1.3 Apply the concepts of the foundation in scientific knowledge and skills necessary for a successful career in medical biotechnology.
- 1.4 Analyze the interrelationships between various science disciplines and biomedical sciences to identify uses of biotechnology in health care.
- 1.5 Compare and contrast the benefits and risks of biomedical science found in research.
- 1.6 Analyze and demonstrate proficiency in reading and interpreting biomedical research.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student will:

- 1.1 Gather, analyze, organize, and interpret information from various sources and draft a paper illustrating the history of biomedical research.
- 1.2 Orally report on the history of biomedical research using National HOSA Research/Persuasive Speaking guidelines.
- 1.3 Demonstrate symbols, abbreviations, and medical terminology usage by implementing National HOSA Medical Terminology and Medical Spelling guidelines.
- 1.4 Construct and present a career visual model explaining all facets of a biomedical career using the HOSA Career Health Display guidelines and grading rubric.
- 1.5 Create and develop a public service announcement explaining to the lay person the benefits and risks of biomedical research, using HOSA Public Service Announcement guidelines and grading rubric.
- 1.6 Using the Internet, search for new and emerging biomedical research; summarize information and present it to the class using technology.

SAMPLE PERFORMANCE TASK

- Use flash cards and practice usage of symbols, abbreviations, and medical terminology in note taking.
- Create a poster and exhibit for demonstrating biomedical careers with special attention to the areas of medical biotechnology.
- Find four sites, identifying educational requirements and salaries, on the Internet for each biomedical career.
- Find one career that includes training outside of science, such as business or law.
- Create a timeline of the history of biomedical research, highlighting key discoveries.
- Successfully debate the risks versus benefits of biomedical research.
- Read and report on a biomedical journal article.
- Investigate presence of biotechnology in health care and present findings as a scientific research project.

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STANDARD 2.0

The students will demonstrate proficiency in understanding basic skills and safety in the laboratory.

LEARNING EXPECTATIONS

The student will:

- 2.1 Read, interpret, verbalize, and apply policies and procedures appropriate to the biomedical research setting.
- 2.2 Using math skills to show proper use of exponents, decimals, conversions, dilutions and morality.
- 2.3 Demonstrate safe use of laboratory skills and equipment:
 - a. Pipette skills and identify types of pipettes
 - b. Identification of equipment and glassware
 - c. Identification of microscope parts, its use, and cleaning for storage
 - d. Proper use and safety of a centrifuge
- 2.4 Utilize proper communication, critical thinking, and problem solving techniques.
- 2.5 Demonstrate proficiency with biotechnology laboratory equipment.
- 2.6 Compare and contrast OSHA regulations that are specific to the biotechnology profession.
- 2.7 Investigate raw materials used in biotechnology laboratory setting.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student will

- 2.1 Research policies and procedures appropriate to reporting and documenting research findings in a biomedical research setting and document the information.
- 2.2 Use math skills and show proper use of exponents, decimals, conversions required in a medical biotechnology setting.
- 2.3 Demonstrate use of microscope and centrifuge.
- 2.4 Apply concepts of critical thinking, problem solving, and communication skills to areas of biotechnology.
- 2.5 Utilizing HOSA Biotechnology guidelines, identify laboratory equipment.
- 2.6 Demonstrate proficiency working with microorganisms important in biomedical research.
- 2.7 Role-play situations in a medical biotechnology lab to prevent injury to lab personnel where communication and critical thinking skills are utilized.
- 2.8 Compare OSHA guidelines in a medical biotechnology setting and other laboratory settings.

2.9 Research all materials used in the biotechnology lab with emphasis on raw materials.

SAMPLE PERFORMANCE TASK

- Create a laboratory policy and procedure manual for a biotechnology/biomedical work site.
- Demonstrate understanding of morality and dilution with laboratory solutions such as saline (0.1M NaCl).
- Prepare sterile media and agar plates, grow a bacterial culture (such a those found in sweet aphidophilis milk), and determine the titer of cells in the culture.
- Each student will develop a list of supplies that are needed in a medical biotechnology setting, then, compare the list.
- Print from the Internet pictures of supplies and equipment and demonstrate use of basic equipment in a laboratory setting.

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STANDARD 3.0

The student will apply social and ethical issues related to medical biotechnology.

LEARNING EXPECTATIONS

The student will:

- 3.1 Investigate current bioethical issues and how they will affect the health care profession.
- 3.2 Critique intellectual property rights related to biotechnology.
- 3.3 Distinguish between ethics, morals, and values as related to bioethics.
- 3.4 Develop logical arguments surrounding bioethical issues including but not exclusive to stem cell research, gene patenting, cloning, bioterrorism, and somatic gene cell therapy.
- 3.5 Identify and explain the U.S. agencies and regulatory boards related to biotech products.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student will

- 3.1 Identify bioethical issues that are current and present a written and oral report.
- 3.2 Construct a written paper, oral presentation or blog for a Web site on types of intellectual properties and how they affect lives of Americans.
- 3.3 Explain the process for applying for a patent and all the parts of a biotechnology patent.
- 3.4 Interpret scientific, political, religious, ethical, and philosophical disagreements related to medical biotechnology.
- 3.5 Investigate bioethical issues and present pros and/or cons for each development or research that is occurring.
- 3.6 Explain what is meant by responsible conduct of research in relation to biotechnology.
- 3.7 Identify all governmental regulatory agencies related to biotechnology

SAMPLE PERFORMANCE TASK

- Research current bioethical issues and present facts in class
- Utilize National HOSA Biomedical Debate to debate current bioethical issues.
- Research medical biotechnology patents and the process to get them fully implemented.
- Develop a potential biotechnology product and complete application for patent.
- Develop written, verbal, or visual project that explains the governmental regulatory agencies of medical biotechnology.

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STANDARD 4.0

The students will demonstrate an understanding of the relationship between protein and DNA

LEARNING EXPECTATIONS

The student will:

- 4.1 Compare and contrast the four different classes of proteins.
- 4.2 Investigate the structure of protein.
- 4.3 Analyze and demonstrate protein separation using chromatography.
- 4.4 Relate the structure of DNA to its functions.
- 4.5 Outline the stages involving transcription and translations.
- 4.6 Describe the role of a plasmid and restriction enzyme.
- 4.7 Compare transformation, gel electrophoresis, and polymerase chain of reaction and report the findings.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student will:

- 4.1 Using the Internet, find examples of protein used in research.
- 4.2 Using National HOSA prepared speaking guidelines, present findings to class.
- 4.3 Demonstrate knowledge of protein purification by separating compounds with chromatography.
- 4.4 Construct a DNA model.
- 4.5 Create a poster or electronic slide presentation differentiating transcription and translating.
- 4.6 Use a diagram demonstrating plasmids and restriction enzymes.
- 4.7 Using the Internet, or software find an view virtual lab demonstration of transformation, electrophoresis, and PCR.

SAMPLE PERFORMANCE TASK

- Analyze various products using chromatography
- Demonstrate knowledge of protein purification by monitoring protein separation using chromatography.
- Prepare an oral report on the different methods of purifying proteins.
- Read a biomedical research article that utilizes protein purification.

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STANDARD 5.0

The students will understand basic hematology.

LEARNING EXPECTATIONS

The student will:

- 5.1 Understand the anatomy and physiology of the human immune system
- 5.2 Describe the composition and function of blood and various cell types.
- 5.3 Demonstrate an understanding of how the human immune system works.
- 5.4 Demonstrate an understanding of stem cells and their importance in development of tissues.
- 5.5 Demonstrate proficiency in identifying blood cells using microscopic images.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

The student will:

- 5.1 List all the components found in circulation of blood and how the various cell types function.
- 5.2 Describe the various components of the human immune systems and how they function.
- 5.3 Use the Internet to find examples of scientific knowledge gained from stem cells. Using National HOSA prepared speaking guidelines, present findings to class.
- 5.4 Create a chart identifying the various type of blood cells.

SAMPLE PERFORMANCE TASK

- Demonstrate understanding of how the various components in blood function by presenting a electronic slide presentation using images from the Internet.
- Describe how the human immune system works against bacterial and viral infections, inflammation, and autoimmune disorders.
- Prepare an oral report on experiments involving stem cells.

BIOMEDICAL SCIENCE

STANDARD 6.0

The student will have an understanding of serology and immunology related to Biotechnology.

LEARNING EXPECTATIONS

- 6.1 Apply medical terminology related to serology and immunology.
- 6.2 Compare and contrast antigens and antibodies.
- 6.3 Demonstrate knowledge of immunoglobulin and their functions.
- 6.4 Analyze various diagnostic tests and the antigen-antibody reaction.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

- 6.1 Utilize National HOSA medical terminology guidelines to relate serology and immunology terms.
- 6.2 Differentiate the five classes of immunoglobulin by creating a chart.
- 6.3 Using a simulated or over the counter test kit, demonstrate an antigen-antibody reaction.

SAMPLE PERFORMANCE TASK

- Prepare an oral report on autoimmune disease.
- Perform a diagnostic test using a simulated kit such as pregnancy and/or blood typing.

BIOMEDICAL SCIENCE

STANDARD 7.0

The student will understand basic microbiology.

LEARNING EXPECTATIONS

- 7.1 Demonstrate the knowledge and use of microbiology.
- 7.2 Compare and classify different microorganisms.
- 7.3 Compare and contrast different organisms according to their gram stain properties.
- 7.4 Demonstrate knowledge of specimen collection.
- 7.5 Explain how to streak for isolation.
- 7.6 Explain how microorganisms play a role in the biotechnology field.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

- 7.1 Utilize HOSA Medical Terminology guidelines to exhibit knowledge of microbiology terminology.
- 7.2 Utilize National HOSA Biotechnology guidelines to demonstrate laboratory skills.
- 7.3 Perform a gram stain and correctly identify microorganisms present.
- 7.4 Distinguish gram positive from gram negative organisms according to their distinct morphological shapes.
- 7.5 Role-play a demonstration of collecting a specimen to be used in a microbiology lab.
- 7.6 Streak an agar plate or simulate procedures for isolation.
- 7.7 Relate the multiple areas of biotechnology that are influenced or related to microorganisms.

SAMPLE PERFORMANCE TASK

- Make an agar plate smear by heat fixing.
- Prepare a gram stain.
- View organisms under microscope or on Internet.
- Streak an agar plate for isolation.
- Document journal entries daily on the growth of the microorganisms in an agar plate.
- Investigate the other industries that have been affected by microorganisms, such as food and bioterrorism.

BOMEDICAL SCIENCE

Standard 8.0

The student will demonstrate knowledge of the scientific method in research and design.

LEARNING EXPECTATIONS

- 8.1 Demonstrate understanding scientific method.
- 8.2 Compare and contrast hypothesis and theory as it related to scientific method.
- 8.3 Investigate the process of development of new products in a pharmacy.
- 8.4 Formulate a list of activities of medicine that have been influenced or changed by biotechnology.
- 8.5 Collect and display areas of biotechnology in agriculture and how it could affect the medical community.
- 8.6 Investigate the role of biotechnology in bioterrorism and the role of the laboratory staff.

PERFORMANCE INDICATORS: EVIDENCE STANDARD IS MET

- 8.1 Describe the steps of the scientific method and apply it to an activity.
- 8.2 Research and present information concerning hypothesis and theory with comparison and contrast.
- 8.3 Create a marketing plan for promotion of a newly developed pharmaceutical product.
- 8.4 Research and present information concerning activities in medical field
- 8.5 Compile information related to biotechnology, agricultural and medical implementations.
- 8.6 Summarize bioterrorism agents and how health care should be ready to react.

SAMPLE PERFORMANCE TASK

- Have students read a research article and identify steps of scientific method.
- Use the Internet to find a research project related to health care discoveries. Write a synopsis of the research and provide visual explanation for class.
- Develop a marketing plan to health care providers on a new medication and include research attached to the medication.
- Research biotechnology in medicine, pharmacy, and agriculture; then, design your own product from research stage to production stage.
- Investigate U. S Department of Bioterrorism and Medical Reserve Corp to determine their plans for containment in the event of a biotechnology disaster.
- Develop a public health emergency plan for your school if a bioterrorism attach should occur.